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An Analysis of the Relative Efficacy of Advanced Organizers, Post Organizers, Interspersed Questions, and Combinations Thereof in Facilitating Learning and Retention from a Televised Lecture

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ABSTRACT

Cognitive organizers and interspersed questions have been demonstrated to facilitate learning from written material. This study investigated the effects of advance organizers, post organizers, and interspersed questions as procedures for improving learning from video-taped lectures. Ninth graders (N = 176) were assigned at random to eight isolated and combined instances of advance organizers, post organizers, and questions; one group was instructed without the use of adjunct material. Learning was evaluated through a multiple-choice test, and the results were subjected to analysis of variance and to Scheffe *post hoc* procedures. Significant effects were found for interspersed questions. Neither advance nor post organizers resulted in increased learning.

IN ANY learning situation, what is learned is dependent not only upon the subject matter, but upon the teaching-learning process, the environmental conditions at the time of instruction, and the intra-psychic activities of the students as well. When the student is considered as an active agent in his own learning, it becomes necessary to emphasize the discovery of ways of managing those student activities and processes which give rise to learning. Recently the use of adjunct materials, particularly cognitive organizers and interspersed questions, has been demonstrated by several investigators (1, 4, 5, 11, 13) to have a facilitative effect upon learning from written materials.

Advanced organizers have been conceptualized by Ausubel (5) as a form of verbal mediation in which concepts or principles are introduced before the main body of instructional material to facilitate learning and retention. Recent research by Bauman and others (7) suggests that organizers are also helpful when presented at the end of the material to be learned.

Rothkopf (12, 14) has studied attention processes involved in learning from written materials and reports that interspersed questions, test-like events interspersed in written material, improve learning by providing self-awareness of knowledge and by initiating attentional processes in the learner.

Basic problems in learning from written material, such as gaining the attention of the learner, are also present when learning from oral instruction. The focus of this research was to evaluate the effect of organizers and interspersed questions as means to facilitate the learning of material presented in televised lectures. Specifically, the study had three major purposes: (a) to examine the differential effect of organizers when used as introductory material (advance organizers) and when used as summary material (post organizers); (b) to examine whether interspersed questions affect learning and retention; and (c) to examine whether advance organizers, interspersed questions, and post organizers, when used simultaneously, contribute to maximize learning and retention.

Treatment

Students from the Oconomowoc,[2] Wisconsin, Junior High School (N = 176) were randomly assigned to the eight experimental conditions shown in Table 1.

The subject-matter of the video-taped lessons was concerned with the origins and production of atomic energy. This subject was chosen because the basic principles of atomic energy were unfamiliar to the students in the junior high science program in the school of the study. Yet these principles were related to science concepts previously learned by the students; therefore, this particular topic was deemed to be susceptible to meaningful incorporation within the Ss' structure

Table 1.—Levels of Treatment to be Compared

Experimental Groups	Instructional Structure of the Lessons*		
Group 1	A.O.*	I.Q.	P.O.
Group 2	A.O.	——	P.O.
Group 3	A.O.	I.Q.	——
Group 4	A.O.	——	——
Group 5	——	I.Q.	P.O.
Group 6	——	——	P.O.
Group 7	——	I.Q.	——
Group 8	——	——	——

*A.O. = Advanced Organizers; I.Q. = Interspersed Questions; P.O. = Post Organizers

of knowledge as is required for meaningful verbal learning.

The advance and post organizers were identical in content. They were written on a higher level of abstraction, inclusiveness, and generality than the material covered in the lessons. The interspersed questions were inquiry-oriented, seeking to motivate the Ss to find out the reason for an event or scientific fact. The questions were followed by 2 to 3 seconds of silence to distinguish them from the basic content and to promote attention.

In learning from written material it has been found (8) that questions placed every ten sentences, and after the material to be learned, give better results than other combinations. With written material the reader has the opportunity to reread to find the answer to the question being asked. Such review is not possible when learning from a televised lecture. For this reason, in the video-tapes, the interspersed questions were placed in front of their referent material. Within limitations imposed by the content, fifteen questions were evenly distributed throughout the lesson.

The lectures without organizers were 6 minutes shorter than the rest of the lectures which were 30 minutes in length. To control for this time difference "neutral material" was added accordingly. Test questions were neither the same as the interspersed questions nor were they taken from organizer or neutral material.

Evaluation Instrument

To obtain an achievement test to provide information about group or treatment differences, a pretest consisting of forty, 4-choice items was given to eighty-six ninth-grade Ss after they viewed the video-taped lesson with all adjunct materials. The pretest results were submitted to an item analysis with the General Item Test Analysis Package (GITAP) section of the Fortran Test Analysis Program (FORTAP) (6) of The University of Wisconsin Computing Center.

The final form of the test consisted of thirty items which approached minimum achievement test standards (9) with one correct answer and three distractors per question. The content validity of items was based on the concurrent opinion of two science teachers. The internal consistency reliability determined by the Hoyt ANOVA was found to be .76. The results of the tests were analyzed through a 2×2×2 factorial design to separate main and interaction effects. The significant main effect was analyzed through a Scheffe *post hoc* test (10).

Design Decisions

Walster and Cleary (15) have criticized the traditional method of statistical decision making. They say that

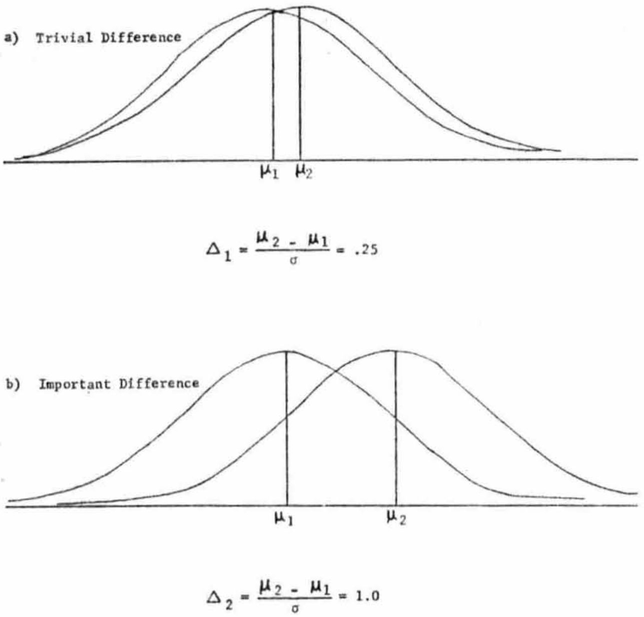
> . . . *the results of fixing α and letting N vary without regard to the quality of decisions of interest will result in a decision-making procedure whose outcome is more a function of sample size than of the magnitude of effects of interest.*

Therefore, the researcher needs to specify the range of positive effects he will consider trivial and the range for larger effects he will consider important. For the two sample cases an index of the magnitude of an effect which is closely related to the noncentrality parameters of the noncentral t and F distributions is $\triangle = (\mu_1 - \mu_2)/\sigma$ or its absolute value for nondirectional hypotheses.

In addition to specifying the magnitudes of trivial and important effects, the experimenter will wish to control the probabilities of correctly drawing the conclusion that there is a trivial or important effect. If D_1 is the decision that denotes a trivial effect and D_2 the decision that denotes an important effect, then the experimenter can specify lower bounds on the probability, P_1, of correctly making D_1, and P_2, of correctly making D_2. To analyze for main and interaction effects P_1 and P_2 were set at .95 with $\triangle_1$ and $\triangle_2$ set at .25 and 1.0 respectively (see Figure 1).

Using the program described by Walster and Cleary (15), the minimum sample size required was found to be 176 observations or twenty-two Ss per group. The critical values for the variance ratio statistic are: $C_1 = 3.83$ and $C_2 = 4.02$. The decision rule to be followed was: If the observed variance ratio statistic, F, is less than C_1, make decision D_1; if F is greater than C_2, make D_2; if $C_1 < F < C_2$ decide that $\triangle_1 < \triangle < \triangle_2$.

Figure 1.—Graphic Representation of the Index of the Magnitude of the Effect to be Considered Trivial ($\Delta_1 = .25$) and the Magnitude of the Effect to be Considered Important ($\Delta_2 = 1.0$).



Procedures and Results

The video-taped lessons were presented to students in their regular classrooms during school hours with students assigned at random to groups and groups assigned at random to treatments. The criterion test was administered 1 day after the experimental treatment. To minimize individual differences due to speed factors, no time limit was given for completion.

According to the established criteria ($F = 3.83$) for trivial effects and ($F = 4.04$) for important effects the test for interaction effects was found to be nonsignificant (see Table 2). Since there were no significant interactions among the experimental factors, it was judged appropriate to further analyze the hypotheses. The F-test for main effects (advance, post organizers, and questions) was found significant (see Table 2). This overall significance indicates that one or more treatment comparisons (see Tables 3 and 4) were significantly different from zero.

Table 3.—Means and Sample Sizes for Each Cell in the Design of the Study (N = 22)

	Advance Organizers		No Advance Organizers	
	Post Organizers	No Post Organizers	Post Organizers	No Post Organizers
Interspersed Questions	16.82	15.85	17.41	17.95
No Interspersed Questions	13.09	14.85	13.36	14.86

Table 4.—Means and Sample Sizes for Each Treatment Level Collapsing over Cell (N = 88)

	Treatment With	Treatment Without
Advance Organizers	15.88	15.89
Post Organizers	15.17	15.90
Interspersed Questions	17.01	14.06

Table 2.—Analysis of Variance and Scheffe Test of Effects for Advance, Post Organizers, and Interspersed Questions on Learning from a Video-Taped Lesson

Source	df	Sum of Squares	Mean Square	F	Scheffe Test
Main Effect	3	427.698	142.566	6.22*	
A.O.	1	22.551	22.551		.328
P.O.	1	24.006	24.006		.349
I.Q.	1	381.142	381.142		4.451*
Interaction	3	59.880	19.960	.856	
AO X PO X IQ	1	9.551	9.551	.417	
Error Term	168	3846.528	22.896		

* Meets the criteria for significance established in advance by the Walster and Cleary (15) procedure.

To determine the source of overall significance, the three treatments—advance, post organizers, and interspersed questions—were considered levels of a general main effect. A Scheffe procedure (see Table 2) was used to test the triviality or importance of each F-ratio (10). The results indicate (a) no significant differences across treatments for advance and post organizers, (b) a significant difference across groups with and without interspersed questions. Since a significant difference did occur between means resulting from lessons with and without interspersed questions, it was inferred that the use of interspersed questions contributed to the learning and retention of the material in the televised lesson.

Discussion

The purpose of this study was to evaluate whether adjunct materials, advance and post organizers and interspersed questions, proven useful in learning from written material, would also be useful in learning from televised lectures. Results of these analyses showed that advanced and post organizers did not produce any significant effect but that interspersed questions made a significant contribution to learning and retention from the experimental lessons.

Failure to obtain a significant increment in learning and retention from the use of cognitive organizers might have been due to their degree of abstractness. Ausubel's theory of meaningful verbal presentation of subject matter is dependent upon the existence of a fairly stable cognitive structure in the learner and is also dependent upon the assumption that empirical and nonverbal experiences are not a necessary pre-condition to meaningful learning. Ausubel (3) suggests that these requirements are met approximately in the junior high school years for most students, although this might vary within the same individual for different subject matter areas and will certainly vary across individuals.

It can also be argued, as has been pointed by Bauman and others (7), that conflicting results concerning the effect of organizers might be due to the construction and content of the organizers. If the content or symbols employed in the organizers were too abstract for individuals (ninth graders) beginning to grasp abstract concepts, the predicted facilitative learning expected from the organizers would not be manifested. The validity of this argument should be tested by repeating the same experiment at a higher school level or through the use of a simpler organizer for the same lesson.

It is also possible that the facilitative learning and retention effect of advance organizers found by Ausubel (2), Ausubel and Fitzgerald (3), and Ausubel and Youssef (4) is only valid in learning from written material and is not transferable to learning from televised instruction. To further analyze this possibility this experiment could be replicated with a similar sample using the videoscripts as written learning material. Subsequently, the effect of the learning material with and without organizers could be compared with the corresponding video lessons.

With respect to the interspersed questions, the results showed that they made a significant contribution to the learning and retention of the video-material. Interspersed questions appear to improve learning from video-taped materials as well as from written materials.

The effectiveness of the questions may have been due to the few seconds of silence. The silence was employed (a) to make the viewers notice that a question had been asked by the lecturer, and (b) to give the viewer time to think about what was being asked. When learning from written material this information processing is normally accomplished during a pause in the reading. Another possibility is that the silence develops an attentional effect, thus "forcing" the viewer to translate the nominal stimuli (interspersed questions) into effective stimuli. Anderson (1) explains that, in the narrow sense, noticing a stimulus is a necessary but not sufficient condition for learning. To be useful, the stimulus must also be handled in a meaningful manner. This handling involves, according to Anderson, an internal representation of the thing or event evoked in the words. Accepting this assumption, it could also be argued that the silence that followed the questions enabled the viewer to "internally" code the questions.

Finally, it is also possible that the interspersing of questions during the video-lecture may have produced a facilitative learning effect only because it was a novel experience to Ss. Few teachers in the junior high school systematically use interspersed questions. If the results were dependent upon this novelty effect, their facilitative effect might become nonsignificant once learners adapted to this format.

Summary

The problem of this study was the evaluation of advanced organizers, interspersed questions, and post organizers as procedures for improving learning and retention from a video-taped lesson. Four questions were stated for specific investigation. The analysis of the dependent variables (test scores) leads to the following conclusions:

> 1. *The acquisition and retention of knowledge from video-taped lessons* was *significantly affected by the use of interspersed questions.*
> 2. *The acquisition and retention of knowledge from video-taped lessons* was not *significantly affected by the use of an advance organizer.*
> 3. *The acquisition and retention of knowledge from video-taped lessons* was not *significantly affected by the use of post organizers.*

4. No interaction effects were found between the three experimental factors.

Several hypotheses to explain the results were generated; further research was recommended.

FOOTNOTES

1. The authors gratefully acknowledge the help received from Prof. William Walster in formulating and applying the statistical treatment of the data.
2. Dr. William Paton, Superintendent, and John Koehn, Junior High Principal, were particularly helpful in facilitating this research. Terry Krall and Jerry O'Neil, science teachers, provided valuable feedback on the lesson, tests, and video-tapes.

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